STEREO Space Weather Group Update

Space Weather Group Website:

- **Group leaders: Dave Webb & Doug Biesecker**
- **Website being updated now:**
  http://secchi.nrl.navy.mil/index.php?p=SpaceWeather
  Webmaster is Lynn McNutt of NRL/SECCHI
- **Contains background on SWx, SWx-related meetings, PI SWx, tools/projects, references & links**
- **Maintaining a list of URLs/links that all PI teams can use**
  Current list: NASA STEREO The Sun in 3D, STEREO, GOES SXI, Solar Mass Ejection Imager, SHINE, TRACE, NSF National Space Weather Program, NOAA SWPC, Hinode, ESA's Space Weather Program, ACE, SDO, NASA Living With a Star, WIND, CCMC, The International Heliophysical Year, SOHO, VSO, AF Space Weather Center of Excellence, Ulysses, SIDC, LESIA STEREO Radio Monitoring, LMSAL EUVI, LMSAL Latest Events
- **Maintain member list with email addresses**
  Currently have 120 members
  Contact me to join (david.webb@hanscom.af.mil) or request to subscribe at http://ares.nrl.navy.mil/cgi-bin/majordomo
- **Tools/Projects list *(Next)***
  Need updates from each team
  Interactions with STEREO Teams & SSC

E WEATHER TOOLS

etric Localization of STEREO CMEs (V. *Pizzo & D. Biesecker, 2004; NOAA*)
zing a series of LOS's from two views to define the location, shape, size &
of CME. To be automated & used to decide whether & when CME will impact Eart

Model Predictions *(N. Arge, J. Luhmann, D. Biesecker; AFRL, UCB, NOAA;*
& Pizzo, 2000)
g-Sheeley-Arge and ENLIL 3D MHD solar wind models will be integrated.
routine predictions of vector solar wind velocity, density, temp. & mag. polarity
e desired. Also a joint AFRL/CISM/SEC project.

tection:
US – Computer Aided CME Tracking *(E. Robbrecht & D. Berghmans, 2005; ROB)*
ltime tool for detecting CMEs in SECCHI images. Outputs: QL CME catalog
ures of time, width, speed; NRT CME warnings. Successfully tested on SOHO
MEs. Latest COR2 runs at http://sidc.oma.be/cactus/secchi/SECCHI_CMEs.html

Solar Eruptive Event Detection System *(J. Zhang et al.,; GMU)*
detecting, classifying & analyzing CMEs in SECCHI images. Outputs: Automatic
alog w/measures of time, width, speed; NRT CME warnings. Being tested on
MEs.

d Automatic CME Detection Algorithm (*E. De Jong, P. Liewer, J. Hall,*
& R. Howard) ; JPL, NRL
m based on feature tracking which uses 2 successive images to determine
or not a CME has occurred. Algorithm to be run on board spacecraft.

E-Related Features Detection:

omputer Aided EUVI Wave and Dimming Detection
Podladchikova, D. Berghmans, A. Zhukov; ROB;
Podladchikova & Berghmans, 2005)
T tool for detecting EUV waves & dimming regions. Tested on SOHO EIT images:
p://sidc.oma.be/nemo/. SECCHI?

ocity Map Construction *(J. Hochedez, S. Gissot; ROB)*
gram to analyze velocity flows on SECCHI images; detect CME onsets & EUV wav
T warnings of fast CMEs; reconstruct 3D velocity maps of CMEs from 2D maps fr
h STEREO.

omatic Solar Feature Classification *(D. Rust, P. Bernasconi; JHU/APL)*
l for detecting and characterizing solar filaments and sigmoids
ognition & Classification in solar images.
l is to meas. magnetic helicity parameters & forecast eruptions using
ments & sigmoids.

SPACE WEATHER – ENABLING PROJECTS

❖ **Identifying and Tracking CMEs with the Heliospheric Imagers** ***(R. Harrison, C. Davis; RAL)***
Produced simulations to show model CMEs can be identified & tracked with HIs. Use triangulation to measure speed & direction of CMEs & forecast their Earth arrival.

❖ **Structural Context of Heliosphere Using SMEI Data** ***(D. Webb, B. Jackson; BC/AFRL, UCSD; Jackson et al., 2006)***
Use analyses of SMEI images to provide structural context of the heliosphere for COR2 & HI; Provide complementary observations of transient disturbances.

Interplanetary Acceleration of ICMEs ***(M. Owens; BU)***
Construct acceleration profiles of fast ICMEs over a large heliocentric range using multi-point HI to understand the forces acting on ejecta. Improve predictions of arrival times of ICMEs at Earth.

Relationship Between CMEs and Magnetic Clouds ***(S. Matthews; MSSL)***
Assess the potential geoeffectiveness of CMEs based their association with magnetic clouds. What particular characteristics lead to production of a magnetic cloud?

3D Structure of CMEs (*V. Bothmer, H. Cremades, D. Tripathi; MPI, Ger., Cambridge, UK; Cremades & Bothmer, 2004*)
Program to compare analysis of SECCHI images on the internal magnetic field configuration & near-Sun evolution of CMEs with models based on

DATA BROWSERS AND VIEWERS

❖ **STEREO Science Center Real-Time Data Pages *(W. Thompson et al)***
Main public site for viewing R/T STEREO data.
http://stereo-ssc.nascom.nasa.gov/beacon/beacon_secchi.shtml

❖ **Solar Weather Browser *(B. Nicula, D. Berghmans, R. van der Linden; ROB)***
User-friendly browser tool for finding & displaying solar data & (SWB) context information. Available at http://sidc.oma.be/SWB/

STEREO Key Parameters *(C. Russell & IMPACT, PLASTIC & SWAVES teams; UCLA)*
An easily browseable Merged Key Parameter data display including the in-situ & SWAVE radio data from STEREO.

❖ **Carrington Rotation In-situ Browser *(J. Luhmann, P. Schroeder UCB)***
Browser for identifying in-situ events & their solar sources at CR-time scales.
Includes near-Earth (ACE) data sets for third point views & image movies from SECCHI & near-Earth (SOHO).
See: http://sprg.ssl.berkeley.edu/impact/data_browser.html.

JAVA-3D Synoptic Information Viewer *(J. Luhmann, P. Schroeder UCB)*
JAVA-3D applet for viewing 3D Sun & solar wind sources based on synoptic solar maps & potential field models of the coronal magnetic field.

❖ **Radio Monitoring and CME Data Pages *(M. Pick et al.)***

STEREO Space Weather Events pages

- **Based on old ISTP Sun-Earth Connection Events site:**
  http://www-istp.gsfc.nasa.gov/istp/events/

  Example:

Sun-EARTH Connection Event: July 14-16, 2000

X-Class Flares and Fast moving Earth-directed CME. The aurora reached as far south as Georgia (although not visible as during daylight) and Great Britain.

- **First STEREO SWx event is Dec. 13(- 14), 2006**
  First and still the best STEREO SWx event!
  Other possible events?

- **Contains an event summary, online data, modeling & links to other data**
  Need to incorporate or link other STEREO data:
    Beacon (NRT quicklook)
    SECCHI & SWAVES imagery
    PLASTIC & IMPACT in-situ plots
  Need more geo inputs!
  Try to develop new events/pages soon after events occurrence

DFW, STSWG,Caltech,

Incorporating Data from Other Sources

- *Existing Data:* ACE, Wind WAVES & EPACT (MeV protons), SOHO, TRACE, (SXIs), Hinode, Ulysses, SMEI, IPS

- *Future Data:* SDO, MWA/IPS (Faraday rotation), new heliospheric imagers, Sentinels/Solar Orbiter (HELIX), FASR

Are special arrangements needed?

How to combine in-situ & imaging data?

- At SEC Leslie Mayer (Nick Arge) is working on incorporating the STEREO locations into the WSA model. Doing as part of generalization of WSA code:

*** Both mag field expansion factor and the minimum angular distance → open field footpoint to nearest coronal boundary determined by tracing individual field lines down to surface. These two quantities used in an empirical formula to calculate solar wind speed.**

*** The solar wind speed and coronal mag field values determined for each sub-Earth point (at 5 Rs) are then used to predict SW parameters at L1 using 1D kinematic SW model.**

*** Generalizing code so model can be fed orbital coordinates of other**

Update continued

Use of S/WAVES data/displays for space weather *(Next)*

- **Type II, IIIs freq (distance) vs time plot**
- **with imaging & in-situ experiments**

CCMC use of STEREO data as inputs to models

- **Clearly has space weather context**

<u>Future SWx meetings:</u>

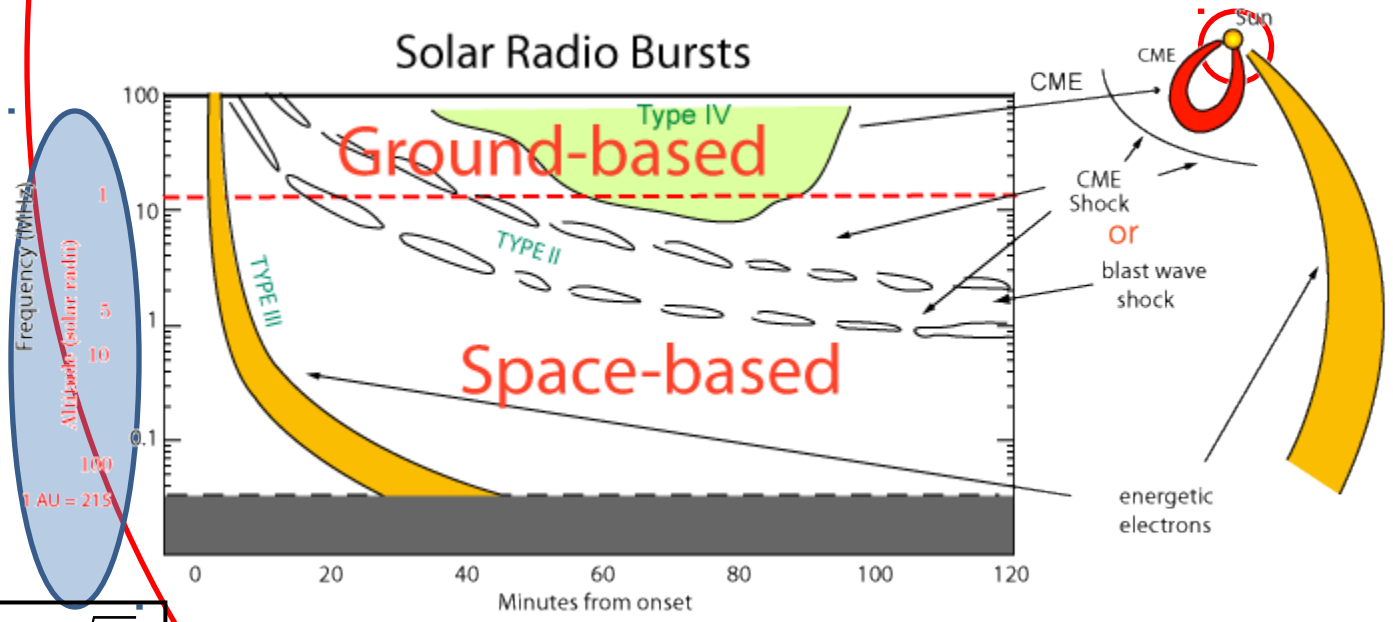
- **Updates at all SWGs & SECCHI Consortia**
- **Separate Space Weather workshop?**

<u>Interfaces with</u>:

- **3D Reconstruction & Visualization Team**
- **Virtual observatories**
- **IHY (add CIPs related to STEREO data & analyses)**
- **Outreach aspects**
  With NASA EP/O & PAO efforts; Press Releases?
  Separate SWx Poster (thru NRL)?
  Possibly a feature article in Space Weather journal

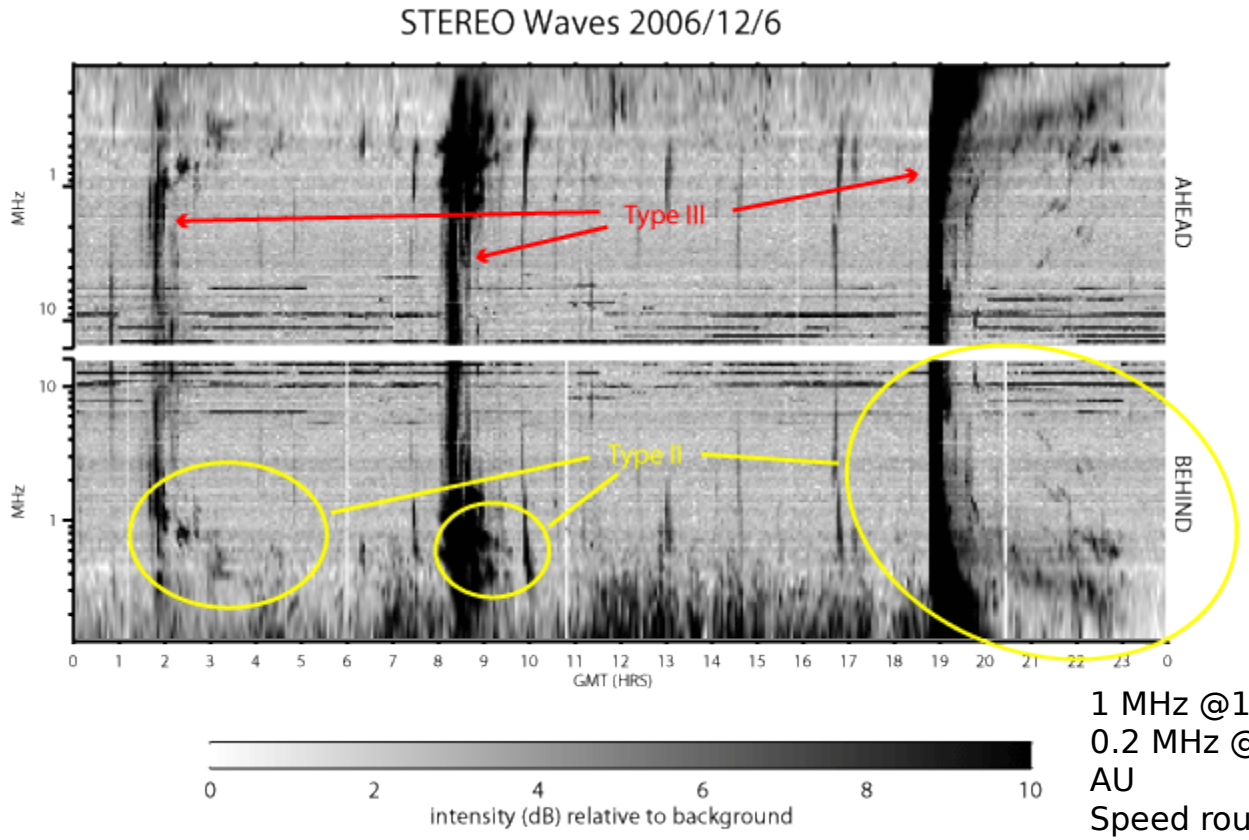
<u>Other ideas; changes???</u>

Solar Radio Bursts – corona to 1 AU



$$f \sim \sqrt{n_e}$$
$$n_e \sim 1/r^2$$
$$f \sim 1/r$$

Courtesy M. Kaiser


STEREO Waves 2006/12/6
Type III
Type II
AHEAD
BEHIND
MHz
1
10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 0
GMT (HRS)
0 2 4 6 8 10
intensity (dB) relative to background

1 MHz @19 UT → at Sun
0.2 MHz @23 UT → at 1/8 AU
Speed roughly 1300 km/sec